I CLAIM:

1. A mirror comprising:

a fiber reinforced substrate;

an optical quality surface on the substrate;

a reflective optical coating on the optical quality surface; and

a fiber reinforced layer between the substrate and the optical quality surface that diffuses print through of any structure from the substrate to the optical quality surface.

2. The mirror of claim 1, wherein the fiber reinforced substrate and said fiber reinforced layer respectively comprise first and second fibers in a matrix material, said substrate being characterized by a first scale factor that is a measure of the structure of the first fibers, said fiber reinforced layer being characterized by a second scale factor that is a measure of the structure of the second fibers and is less than said first scale factor.

3. The mirror of claim 2, wherein the first fibers are bundled into tows and woven into a cloth in the matrix, said first scale factor being at least one order of magnitude greater than said second scale factor.

4. The mirror of claim 3, wherein the diameter of said second fibers is less than the diameter of said first fibers.

5. The mirror of claim 1, wherein the fiber reinforced layer comprises randomly arranged fibrils having a diameter less than 1um and a length at least one hundred times the diameter.

6. The mirror of claim 5, wherein the fibrils have a diameter less than 0.3micron.

7. The mirror of claim 5, wherein the fibrils comprise carbon nanotubes having a diameter less than 0.01 micron in diameter.

8. The mirror of claim 1, wherein the fiber reinforced layer comprises an untowed weave of continuous fibers.

9. The mirror of claim 8, wherein the fiber reinforced layer comprises a towed weave of continuous fibers in which each tow includes less than 200 fibers.

10. The mirror of claim 1, wherein the fiber reinforced layer comprises a mat of continuous fibers.

11. The mirror of claim 1, wherein the optical quality surface is formed in the fiber reinforcement layer.

12. The mirror of claim 1, wherein the optical quality surface is formed in another layer formed on the fiber reinforcement layer

13. A mirror comprising:

a matrix;

a first layer of fibers in the matrix, said fibers having a structural pattern characterized by a first scale factor;

a second layer of fibers in the matrix over said first layer, said fibers having a structural pattern characterized by a second scale factor less than the first scale factor; and

a reflective optical coating over said second layer.

14. The mirror of claim 13, wherein the fibers in the first layer are bundled into tows and woven into a cloth, said first scale factor being a measure of the spacing of the tows in the cloth and having a value at least one order of magnitude greater than said second scale factor.

15. The mirror of claim 13, wherein the fibers in the second layer are arranged in

randomly arranged fibrils, an untowed weave or a mat, said second scale factor being at least one order of magnitude smaller than said first scale factor.

16. The mirror of claim 13, wherein the fibers in the first layer have a diameter of at least 1micron and the fibers in the second layer have a diameter less than 1micron.

17. A mirror comprising:

a substrate including a matrix reinforced with a plurality of fibers bundled into tows and woven into a cloth, said tows having a diameter of at least 0.5 mm;

a layer of fibrils randomly bound in the matrix on the surface of the substrate, said fibrils having a diameter of less than 1 micron; and

a reflective optical coating.

18. The mirror of claim 17, wherein the matrix is a carbon, ceramic, metal or polymer material and the fibers in the cloth and the fibrils are the same material selected from graphite, silicon-carbide, Boron-carbide, Boron-nitride, or boron.

19. The mirror of claim 18, wherein said fibrils have a diameter less than 0.3 micron.

20. A mirror comprising:

a carbon-carbon substrate;

a layer of submicron diameter graphite fibrils randomly bound in the substrate's carbon matrix; and

a reflective optical coating.

21. The mirror of claim 20, wherein the carbon-carbon substrate comprises a plurality of graphite fibers bundled into tows and woven into a cloth in a carbon matrix, said cloth having a center-to-center spacing of at least 1 mm.

22. The mirror of claim 21, wherein the graphite fibrils have a diameter of less than 0.3 micron.

23. A method of constructing a mirror, comprising:

laying a fiber cloth in a mold having a predetermined optical surface shape;

laying submicron diameter fibers on the cloth;

adding a matrix pre-cursor;

pre-heating the mold to carbonize the pre-cursor;

heating the mold to graphitize the matrix;

forming an optical quality surface on the reinforced matrix; and

forming a reflective optical coating on the optical quality surface.

24. The method of claim 20, wherein a matrix pre-cursor is added to the fiber cloth and pre-heated to carbonize the pre-cursor before the submicron diameter fibers are added.

25. The method of claim 23, wherein the optical quality surface is formed by,

machining the surface of the submicron diameter fibers;

depositing a layer of metal, semi-metal or ceramic material; and

machining the layer to form the optical quality surface.

26. The method of claim 23, wherein the fiber cloth comprises a plurality of bundled and woven fibers and the submicron diameter fibers comprise fibrils, an untowed weave or a mat.

27. A method of constructing a mirror, comprising:

providing a graphitized fiber reinforced matrix in a mold having a predetermined optical surface shape;

laying submicron diameter fibers on the matrix;

providing a matrix pre-cursor;

pre-heating the substrate to carbonize the pre-cursor;

heating the substrate to graphitize the matrix;

forming an optical surface; and

forming a reflective optical coating on the optical surface.

28. The method of claim 27, wherein the matrix is reinforced with a plurality of fibers bundled into tows and woven into a cloth and the submicron diameter fibers comprise fibrils, an untowed weave or a mat.